PTO 08-5894

CC = DE
20020523
OLS
10057818

TRACTION MECHANISM DRIVE FOR A STARTER GENERATOR
[Zugmitteltrieb für einen Startergenerator]

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UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. JUNE 2008
TRANSLATED BY: THE MCELROY TRANSLATION COMPANY

PUBLICATION COUNTRY	(19):	DE
DOCUMENT NUMBER	(10):	10057818
DOCUMENT KIND	(12):	OLS
PUBLICATION DATE	(43):	20020523
APPLICATION NUMBER	(21):	10057818.7
APPLICATION DATE	(22):	20001121
INTERNATIONAL CLASSIFICATION[7]	(51):	F 16 H 7/08
		F 02 B 67/06
PUBLICATIONS CITED	(56):	DE 198 49 886 A1
		DE 196 09 420 A1
		DE 43 17 949 A1
		DE 43 06 360 A1
		DE 30 43 287 A1
		DE 73 15 940 U
		DE 70 32 415 U
		DE 68 04 829 U
		DE 689 03 050 T2

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TITLE	(54):	TRACTION MECHANISM DRIVE FOR A STARTER GENERATOR
FOREIGN TITLE	[54A]:	Zugmitteltrieb für einen Startergenerator

Detailed explanation of the invention

[0001]

The present invention relates to a traction mechanism drive which is designed for driving devices of a combustion engine, especially for driving a starter generator. The traction mechanism drive comprises hereby a traction mechanism, such as a belt, preferably a V-ribbed belt. This connects all the pulleys of the traction mechanism drive or the devices to be driven.

Background of the invention

[0002]

Such traction mechanisms are used for driving devices such as water pumps, compressors of air-conditioners, generators as well as power-steering pumps. For such drives, a traction mechanism designed as a continuous belt is used. For the operation of individual devices as well as for achieving a long life span of traction mechanisms, slip-free driving is required of all devices. For this purpose, a tensioning device or tensioning system is to be provided with which a tension roller is guided, impinged upon by a force on the traction mechanism. In order to achieve pre-tensioning of the traction mechanism, mechanical as well as hydraulic tensioning devices or tensioning systems are known.

[0003]

The document DE 43 06 360 A1 shows a tensioning device that comprises a cam. This cam is fixed on a shaft which is inserted in a bearing bushing. Arranged on the lateral surface of the cam is a radial bearing over which a tensioning roller can be rotated. The device is fixed on the combustion engine with a two-armed housing. A pre-tensioning force is produced with the help of a torsion spring. This spring is arranged concentrically to the shaft or bearing bushing and is supported with one spring end on the cam

and the other spring end on the housing. The force exerted by the torsion spring produces a non-positive support of tensioning roller on the traction mechanism.

[0004]

DE 196 09 420 A1 describes a tensioning device with a mechanical-hydraulic actuation element. This device comprises a housing in which a cylinder is arranged at the center for accommodating a piston that can be displaced in the longitudinal direction. In the axial extension of the piston, a fastening lug is provided at the end, with which the hydraulic element can be fixed pivotably onto a tension roller carrier. Another fastening lug is arranged on the housing with which the tensioning device is fixed pivotably onto the combustion engine. The piston used in the cylinder can be displaced in the longitudinal direction. This piston is impinged upon by spring force and bounds a pressure chamber in the cylinder. A piston movement brings about a volume exchange of hydraulic fluid between the pressure chamber and the housing.

[0005]

The known traction mechanism drives are provided for driving many devices by which the traction mechanism that connects all pulleys is subjected to a high alternative bending stress. The life span of a traction mechanism is limited by such a layout of traction mechanism, especially for transmission of high torques.

Summary of the invention

[0006]

Based on the disadvantages of the known solutions, the task of the invention is to develop a traction mechanism drive that is suitable for transfer of high-drive torques and that ensures a long life span of traction mechanisms.

[0007]

To solve this problem, a traction mechanism drive is provided according to the invention which comprises at least two pulleys and does not have a separate tensioning device. The traction mechanism drive according to the invention can be designed as a two-pulley drive with which the traction mechanism exclusively connects the drive pulley and the output pulley. This design does not cause any disadvantageous alternating bending-stress of the traction mechanism and therefore, represents an ideal case for tension of traction mechanisms without an additional, disadvantageous disturbance. The traction mechanism, which is preferably designed as a two-pulley drive according to the invention, is suitable therefore for high drive torques that are required especially for the start mode of a starter generator operation without adversely affecting the life span of the traction mechanism.

[0008]

To influence the traction mechanism pre-tension, the traction mechanism drive in accordance with the invention includes a pivotable starter generator as well as a spring element with which the starter generator is supported, say, on the housing of the combustion engine. Such an arrangement of the starter generator brings about an effective influence on the pre-tensioning of traction mechanism. The starter generator operation requires different traction mechanism pre-tensions depending on the operating mode

of the starter generator, i.e., a starting operation of combustion engine with which the starter generator drives the combustion engine, or the normal operation or generator operation with which the combustion engine drives the starter generator. By varying the arrangement and/or dimensioning of spring element in combination with an appropriate position of the pivot point of the starter generator, the pre-tension can be influenced directly. For example, a higher pre-tension of the traction mechanism can be achieved for the starting operation than for normal operation.

[0009]

The traction mechanism drive that is preferably designed as a two-pulley drive according to the invention along with the pivotable, spring-supported starter generator does not require any separate tensioning device. This is an important cost-saving advantage, whereby the space required for construction is reduced. The two-pulley drive according to the invention with pulleys that are arranged close to each other further reduces the amplitude of the traction mechanism oscillations, which affects advantageously the noise production of the traction mechanism drive. The traction mechanism according to the invention, therefore, represents an ideal case for the given traction mechanism. When compared to the traction mechanism drives used thus far, increased pre-tension forces and traction mechanism forces can be achieved, in addition to an increased life span of the traction mechanism.

[0010]

Other advantageous embodiments of the invention are the objectives of the dependent Claims 2 to 9.

[0011]

The starter generator concept provides that the combustion engine is started or that electrical energy is produced depending on the operating mode. Optionally, a torque is introduced by the starter generator or combustion engine in the traction mechanism via the appropriate pulley. In that case, an exchange of slack strand and tight strand in the traction mechanism takes place between the pulley of the combustion engine and that of the starter generator. Depending on the generator output performance, the torque induced in the generator changes itself. The reaction torque of the starter generator housing changes proportionally to the induced torque.

[0012]

According to another development of the invention, the starter generator is pivoted eccentrically . In that case, the pivot point is on the external contour of the generator housing. The eccentric bearing of the starter generator allows the weight force of the starter generator to have influence on the pre-tension force of the traction mechanism. For example, a displacement of the pivot point of the starter generator in the direction of the working line of the resulting traction mechanism force reduces the pre-tension force of the traction mechanism. Tuning of the force components exerted by the spring element in combination with the position of pivot point allows the required, differentiated pre-tension of the traction mechanism between the start operation and the normal operation of the starter generator.

[0013]

In the start operation of the starter generator, the following balancing of torques takes place. The torque that is produced by the spring element in combination with the appropriate lever arm, along with the torque adjusted in the generator housing, corresponds to the torque caused by the resulting force of

forces working in tight strand and in slack strand and the appropriate lever arm. The total of all the torques working in the pivot point is null. Thus, we can obtain the minimum spring force that needs to be brought about by the spring element. The minimum spring force is set such that the traction mechanism is sufficiently pre-tensioned in the start operation as well as in the normal operation. The torque caused by the weight force of the starter generator is ignored when considering the torque.

[0014]

Likewise, balancing of torques takes place in the normal operation, the generator operation of starter generator. In that case, a torque is induced on the generator disk by which the housing of the starter generator experiences a reaction torque. The torque that is produced by the resulting force of the traction mechanism strand in combination with the appropriate lever arm works in concurrence with the direction of rotation of the reaction torque. The aligned, accumulated torques work against the torque produced by the force of the spring means in combination with the appropriate lever arm. Therefore, a lower pre-tension force of traction mechanism is set for the normal operation when compared to the starting operation. This torque does not take into consideration the torque that is caused by the starter generator weight.

[0015]

Another development of the invention refers to the spring element. This element can be designed as a spring damper unit according to the invention. Such a component has influence on the pre-tensioning of the traction mechanism and, moreover, favors smooth running of the traction mechanism drive, achieving a vibration-free revolution of the traction mechanism. The spring-damper unit compensates

impact-like, impulse-type loads of traction mechanism drive, caused by speed drop of the combustion engine and also due to non-constant power consumption of starter generator.

[0016]

Alternatively to a spring-damper unit, the invention includes a separate arrangement. In addition to the spring element, which is arranged preferably between the housing of the starter generator and the crankcase of the combustion engine, the damping unit is combined with the bearing of the starter generator. Further, the invention comprises a damping unit which is arranged separately from the spring unit, as well as from the bearing of starter generator.

[0017]

Another structural feature of the invention relates to the design of the spring element or spring-damper-unit. These components can be designed effectively mechanically as well as hydraulically according to the invention.

Brief description of the figures

[0018]

A preferred example, shown in two figures, explains the invention. They show:

[0019]

Figure 1, a schematic representation of the traction mechanism drive according to the invention in a starting mode of starter generator, and

[0020]

Figure 2, the traction mechanism drive according to Figure 1 in normal operation.

Brief explanation of the figures

[0021]

Figure 1 shows a traction mechanism drive 1 for driving a starter generator 2, in a schematic representation. Here, the traction mechanism drive 1 comprises two pulleys 3, 4. These pulleys are connected via a traction mechanism 5, preferably a belt. The pulley 3 is connected to the combustion engine 7 via a crankshaft 6. The other pulley 4 is connected directly to the starter generator 2. The combustion engine 7 can be started with the starter generator 2 or electrical energy can be produced. Depending on the operational mode— the starting mode or the normal operation— of starter generator 2, a torque is introduced in the traction means 5 by the starter generator 2 or by the combustion engine 7 via the pulley 3 or pulley 4. Related to this is an exchange of slack strand and tight strand in the traction mechanism 5. The starter generator 2 comprises a housing 8 with an integrated rotor on which the pulley 4 is fixed rigidly against torsion. The housing 8 of the starter generator 2 is pivoted eccentrically on the combustion engine 7. For this, the housing 8 is connected to the combustion engine 7 via a bearing eye 9. A spring element 10 is used for achieving a defined pre-tension force of traction mechanism 5 required for a slip-free drive; this spring element is inserted between the combustion engine 7 and another bearing eye 11 of the housing 8 and a force component that is directed in the counter-clockwise direction is exerted on the starter generator 2.

[0022]

In Figure 1, the torques produced in the starting operation of starter generator 2 are provided with directional arrows. In the start mode, the starter generator 2 drives combustion engine 7. In that case, the starter generator 2 produces a torque M_1 in the clockwise direction. A strand 12 of traction mechanism 5 is for tight strand and strand 13 is for slack strand of traction mechanism 5. Accordingly, the traction mechanism force F_{z2} set in strand 12 is greater than the traction mechanism force F_{z1} set in strand 13. The traction mechanism forces are in the same direction but deviate from each other; they bring about a resulting traction mechanism force. These forces produce a torque M_3 working in the clockwise direction with respect to a pivot point 14, the bearing of starter generator 2 via a lever arm. The torque M_3 is balanced with the torques M_2 and M_4 that operate in the counter-clockwise direction. The torque M_2 is set in the housing 8 of starter generator 2. The other torque M_4 for pivot point 14 is produced by the spring element 10 with the resulting lever arm. The pre-tension forces of traction mechanism 5, i.e., the traction mechanism forces F_{z2} and F_{z1} can be influenced by the spring element 10 and also by displacement of pivot point 14, i.e., the bearing eye 9 of starter generator 2.

[0023]

Figure 2 shows the traction mechanism drive 1 during normal operation or generator operation. In this operation, the starter generator 2, driven by the combustion engine 7, produces energy. The pulley 3 of the combustion engine 7 that rotates in the clockwise direction results in the strand 13 for tight strand and strand 12 for slack strand in the traction means 5. Therefore, traction means force F_{z1} exceeds the traction means force F_{z2} set in the slack strand. Compared to Fig. 1, a reversal of rotational direction of torque M_2 is set in the housing 8 of the starter generator 2. Balancing of torques is obtained by adding

torques M_2 and M_3 that correspond to the torque M_4, which is actuated by the spring element 10 with the appropriate lever arm.

Explanation of symbols

1 Traction mechanism drive

2 Starter generator

3 Pulley

4 Pulley

5 Traction mechanism

6 Crankshaft

7 Combustion engine

8 Housing

9 Bearing eye

10 Spring element

11 Bearing eye

12 Strand

13 Strand

14 Pivot

M_1 Generator-induced torque

M_2 Torque in generator housing

M_3 Torque, produced by the resulting traction mechanism forces

M_4 Torque, produced by the spring element

F_F Force component of spring element

F_{z1} Traction mechanism force

F_{z2} Traction mechanism force

Claims

1. Traction mechanism drive, designed for driving devices of a combustion engine, especially a belt-driven starter generator (2), whereby the traction mechanism drive (1) is designed at least as a two-pulley drive, whose traction mechanism (5) connect all pulleys (3, 4) of the traction mechanism drive (1) and the starter generator (2) is pivoted via a spring element (10); this spring element influences the pre-tension force of the traction mechanism (5).

2. Traction mechanism drive according to Claim 1, whereby exchange of slack strand and tight strand takes place in the traction mechanism (5) depending on the mode of operation— a start mode and a normal mode.

3. Traction mechanism drive according to Claim 1, whereby the starter generator (2) is positioned eccentrically, and, moreover, a housing (8) of starter generator (2) has a bearing eye (10) on an exterior contour.

4. Traction mechanism drive according to Claim 1, with which a torque (M_4) produced by the spring element (10) with the resulting lever arm during starting operation, along with the torque (M_2) in housing (8) of starter generator (2), is balanced with the torque (M_3) produced by the resulting force of traction mechanism strand [(12, 13)].

5. Traction mechanism drive according to Claim 1 with which the torque (M_4) produced by the spring element (10) with the resulting lever arm during normal operation is equal to the sum of torques (M_2) in housing (8) of starter generator (2) and also the torque (M_3) produced by the resulting force of traction mechanism strand (12, 13).

6. Traction mechanism drive according to Claim 1, whereby the spring element (10) is designed as a spring-damper unit.

7. Traction mechanism drive according to Claim 1, whereby the bearing of starter generator (2) is combined with a damping unit.

8. Traction mechanism drive according to Claim 1, with a mechanical spring element (10) or a mechanical spring-damper unit.

9. Traction mechanism drive according to Claim 1, with a hydraulic spring element (10) or a hydraulic spring-damper unit.

Fig. 1

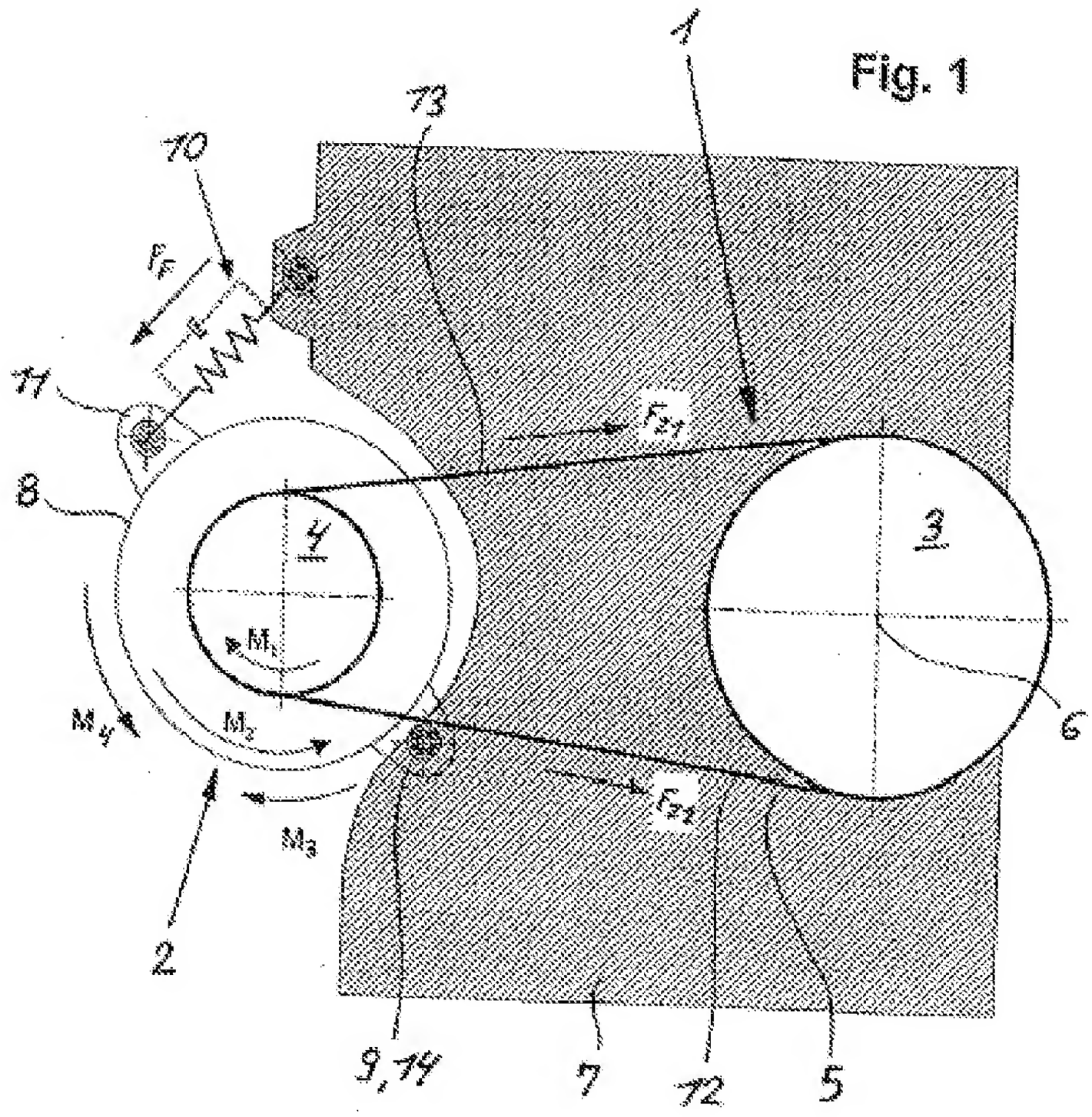

Fig. 2